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ABSTRACT

This computer-based system of enrollment projection predicts up to seven years ahead the number of school children of each age and sex who will be in school. The main distinguishing feature of the system is the ability to detect well in advance small changes in the geographical distribution of children. Forecasts are made for zones that will yield about twenty new pupils each year. Because forecasts are made for these small zones rather than for the area as a whole, it is possible to take special account of local factors that may affect the long-term demand for school places. The forecasting system deals with children attending voluntary schools such as parochial schools, children moving into new houses, children moving in or out of the school system, and children outside the area being studied who request enrollment in schools within the area. The prinicpal use of the forecasting system is in determining the timing and location of new school buildings. After the system is running smoothly, it can also be used to plan teacher assignment, school boundary areas, and transportation plans. The system could also be adapted to forecast populations other than school children. (Author/JM)

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education planning:

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LOCAL GOVERNMENT OPERATIONAL RESEARCH UNIT
Royal Institute of Public Administration

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Every year, local education authorities review their plans for allocating education resources, for recruiting staff, and for building new schools and expanding or reorganizing existing ones. For each of these tasks, the authority needs estimates of the number of children who will require school places in the coming years, although the nature and level of detail required will vary according to the purpose of the forecast.

The Local Government Operational Research Unit has been involved for many years in forecasting, and has carried out a range of forecasting studies, many of them for local education authorities. In the course of this work it has built up experience of a wide range of forecasting procedures, from those designed to predict aggregate totals over the whole school system, to sophisticated methods aimed at predicting the number of children of each age, sex and religion who will require school places in each of a number of quite small geographical areas. These detailed forecasts are particularly useful in determining the siting and timing of primary schools, and can thus help to avoid the problems that can arise when schools are built in the wrong place or of the wrong size.

The Unit has developed a computer-based method of forecasting at this level of detail, which has now been implemented by several local education authorities. This paper describes the special features of the system for those authorities who are interested in applying it, and outlines the steps involved in using it.

WHAT DOES THE SYSTEM DO?

The Unit's forecasting system predicts up to seven years ahead the number of children by age (0 - 18) and sex who will require school places in the authority. Forecasts are made for each of a number of small zones just big enough to yield a new school intake of about twenty children each year.

The main distinguishing feature of the system is the ability to detect well in advance quite small changes in the geographical distribution of children. Because forecasts are made for small zones rather than for the area as a whole, it is possible to take special account of local factors that may affect the long-term demand for school places. This feature of the method means that plans for schools to serve a particular zone or group of zones can be made in full knowledge of the long-term needs of the locality, and that consequently the risks in future years of overcrowding on the one hand or of empty classrooms on the other are considerably reduced.

The forecasting system deals very fully with four groups of children. These are, in order of their importance to the final forecast:

Children Attending Voluntary Schools

Roman Catholic and Jewish churches are legally entitled to provide separate schools for those children whose parents would prefer them to receive denominational teaching. The running costs of these voluntary, or grant-aided schools are paid by the local education authority.

The problem for educational planners arises in determining in advance the number of children who will take up places in these schools, as this can have an affect on the demand for places in state schools. For example, if pressure builds up from parents who would like their children to have a denominational education, but who cannot get places at existing voluntary schools, so the likelihood increases that a new voluntary school will be built. But until it is, the children must be accommodated in state schools; and unless the authority can be fairly certain that a new voluntary school will be built it must make plans to provide extra places of its own. Conversely, in areas where the demand for separate schooling is declining, the authority may have to cater for rather more children in future years than has been the case in the past. It is precisely this uncertainty that creates the problem in planning school places for the future.

In practice, the number of children attending Jewish schools is in most authorities very small in relation to the total child population, so at present no special provision is made for them in the forecasting system. The system does, however, deal comprehensively with the demand for Roman Catholic education. The system makes accurate predictions of the proportion of new-born children in any zone who will be baptised Roman Catholics. By comparing the number of baptisms in successive years with the number of Roman Catholic primary school places currently available, the education department is able to make a reasonable estimate of the likelihood of a new Roman Catholic school, and to take this into account in planning its school building programme.

Obviously these forecasts will also be of interest to the Roman Catholic school authorities. In addition, the forecasting system could easily be extended to cover other religious groups that may be of special importance in some areas.

Children Moving Into New Houses

The ability of the forecasting system to react to changes in the authority's housing stock is one of its strongest features. In most urban areas houses are constantly being built, demolished or converted in some way, all of which will affect the number and age of children in the area. For example, it is well established that children of families in new houses are usually younger than those in older houses, and that flats tend to attract people without children. Over the long term, changes of this type can have an important effect on the sizes of schools required and even on their locations.

The likelihood that families with children will move into a new house or that there will be children in a house to be cleared can be shown to depend very largely on the type of house involved. The forecasting system therefore takes as its starting point a set of relationships for each zone between different types of housing - for example, whether it is a flat or house, whether it is private or council-owned, how many bedrooms it has - and the number and age of the children living there. By using these relationships in conjunction with information on future housing completions, clearance schemes, etc., it is possible to obtain an accurate estimate of the number and age of children who can be expected to be living in the zone in future years.

Children Moving In and Out of the School System

Quite apart from changes in housing stock, there are many other reasons why the number of children of a particular age needing school places in one year will not necessarily be the same as the number of children who were one year younger the year before. Throughout the school year there is a constant movement of children in and out of the school system: their families move, they enter private schooling, they leave school to go to work. To be accurate, a forecasting system must take this movement into account in predicting next year's figures.

The Unit's forecasting system calculates for each zone the proportion of the total children of each age who can be expected to move in and out of the school system each year. Each zone has its own characteristics of migration - for example, the distribution of ages at which children leave school to go to work. However, certain age groups within each zone have similar migration patterns and are therefore considered together. Different proportions are calculated for new and old houses, as it is possible that these have different migration characteristics.

Clearly an increase or decrease in the proportion of children leaving school after age sixteen is a good indication of the future size of sixth forms in the zones concerned. Such changes, while not significantly affecting the accommodation requirements of a school, may have an important bearing on future staffing policies, or on decisions such as whether to set up a sixth form college. If wished, the system could be extended to include those children who transfer from school to higher education.

In the forecasting system as presently formulated, the various reasons for entering and leaving the state school system are grouped together to give one total figure. Provided however that the information was available, or could be made available, any one factor could be isolated and treated separately. One authority, for example, asked the Unit to include in the forecast the number of children attending private schools.

Children Outside the Study Area

Local education authorities are not legally obliged to provide education for children outside their boundaries. Nevertheless most authorities permit some places in schools close to the boundaries to be taken up by children from outside. In order to make full allowance for these children in planning its future school building programme, the education department therefore needs to know approximately how many children fall into this category. The Unit has prepared a special computer program to be run in conjunction with the main forecasting system, which will provide forecasts of these children based on past trends. These predictions must obviously be interpreted in the light of any changes the authority may be considering in its policy towards children outside its area.

HOW DOES IT DO IT?

Forecasts are made for each of a number of small zones of about 900 - 1300 people, which are formed by amalgamating census enumeration districts according to certain criteria. These are that each zone should produce approximately twenty new school-age children each year; that it does not cross any 'natural' boundaries of the kind children would not be expected to cross, such as main roads, railways, canals, etc.; and that it is contained entirely within one school catchment area. Once the zones have been defined, a

comprehensive street index is compiled referencing every address in the area to its appropriate zone. This index is updated each year.

Forecasts are made for each zone in turn, seven years at a time. The forecast starts with the 'base population' of the zone. This is all the children classified by age and sex who are living in the zone in the first, or base year of the forecast. It includes children born but not yet at school (0 - 4 year olds) and all children up to age eighteen who are already at school. Information on these children can be obtained and kept up-to-date from school registers and from records maintained by the area health authorities.

Once the base year's population has been established, next year's population is forecast in the following steps:

1. Age the base population by one year.

2. Add the number of children of each age who will be moving into and out of the zone as a result of changes in housing stock. This figure is obtained by applying the child/house relationships referred to above to the predicted number of housing completions and demolitions for the year ahead. The child/house relationships are calculated initially from the results of a household survey in the area and are checked every five years. The number of houses to be built or demolished is provided by the planning department.

3. Add the number of children who will be born in the coming year. To predict the school intake more than five years ahead, it is necessary to calculate the annual birth rate. The best formula for a particular study area is found by regression analysis, and in the two most recent studies has been the ratio over the past five years of births to 0 - 4 year olds. (In a previous study the best formula was found to be the ratio of births to one-year old children.) Each time the forecast is run the appropriate ratio - the births proportion - is automatically reviewed and adjusted against the actual births in the past year, which will include the effect of new housing completions.

4. Add the number of children who will enter or leave the the school system for any other reason. The net migration of children in and out of the zone is expressed as a ratio of the total base population. As with the births

proportion above, this ratio is initially calculated on past information. Information on the movement of school-age children can be obtained from school registers, but information on pre-school children is more difficult to obtain (one source that might be investigated is the immunological records held by the Area Health Authorities). Corrections are automatically made each time the system is run, on the basis of the movement that actually took place.

5. Subtract the number of children who will go to voluntary schools. In its present form, the forecasting system deals specifically only with Roman Catholic children. The proportion of new-born children who will be baptised Roman Catholics is based initially on an analysis of parish registers and is automatically updated each time the forecast is run, using the actual number of baptisms in the previous year. The proportion of children of school age who will attend Roman Catholic schools is found by calculating the ratio of children of each age currently receiving a Catholic education to the total number of children of the same age in education in the zone. Each time the forecast is run the proportion for children of a particular age becomes the proportion for children that age plus one. *

At the end of this process, the system will have forecast the number of children in each zone who will require school places next year: the new 'gross' base. These steps are then repeated six times - with each time the forecast gross base becoming the new base population - to find the number of places that will be required each year over the next seven years. The final computer print out for each zone gives the forecast number of boys and girls of each age, and the proportion of these who will be Roman Catholic.

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* Under this system it is clear that the number of pre-school children who are recorded as Roman Catholics will be greater than the number of Roman Catholic school-age children recorded; either because there are not enough Roman Catholic school places to meet all the demand, or because some Catholic parents want their children to attend state schools. This difference is taken care of in step 4 above, by including 5-year old Roman Catholic children who enter the state school system in the global figure for migration in that age group.

These predictions will be sufficiently accurate to guide decisions on the future programme of school building. Each year the forecast is run again for a further seven years, using the latest information on housing completions, births, migration, Roman Catholic baptisms, etc. In this way a constant check can be kept on changes in the child population that may affect the demand for school places in the future, and adjustments to the building programme can be made as required.

Once sources for the initial data have been identified and the forecasting system has been installed, the task of collecting and filing the data needed to update the system each year is fairly straightforward. For the most efficient operation, it is suggested that the procedures for supplying this information are built into the normal administrative routine of the authority. Arrangements can be made to present the results of the forecast in whatever form is most suitable for the authority concerned.

CONCLUSIONS

The principal use of the forecasting system described in this paper is in determining the timing and location of new school building. By using the system, an education department is able to gain a much clearer picture than has previously been possible of the way in which demand for school places in different parts of the authority will change in the future, and can plan accordingly. Although the predictions for the earlier years can be treated with greater confidence than those for the later ones, the longer term forecasts can provide valuable early warning about probable peaks and troughs in the number of places required.

When the system has been set up and is running smoothly, the detailed results can be aggregated in a variety of ways to provide the information required for other aspects of education management, such as planning the provision of teachers, determining school catchment areas, and making transport arrangements. Additional information, such as indications of the likely demand for further education places and awards, could be obtained by making small modifications to the system itself.

Other local authority services in addition to education could also benefit from the forecasting system. Where no suitable reference system already exists, for example, a small-scale zoning scheme accompanied by an accurate and up-to-date coding directory

for a complete local authority area would be of immense value to departments such as planning and social services, and to other public services such as the Area Health Authorities. Moreover there is nothing to restrict the use of the system specifically to school children. If wished, it could be used to forecast the numbers and expected areal distribution of any other section of the population, from 'blue-collar' workers to old-age pensioners.

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Based on its past experience, the Unit prefers to undertake a short feasibility study in an area before implementing the full forecasting system. This enables us to check the potential sources of local data and to identify any special problems. When the system has been installed, the Unit will make available to the authority all the relevant computer programs and associated running instructions.

If you are interested in the forecasting system, or in discussing possible adaptations of it to meet the needs of your own authority, please get in touch with Dave Chambers at Reading, or David Jackson at Manchester. Addresses and telephone numbers are given at the front of this report.